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Nest-site fidelity of the European pond turtle *Emys orbicularis* (LINNAEUS, 1758) (Testudines: Emydidae) in western Poland

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Abstract. 59 nests of the European pond turtle *Emys orbicularis* (L.) were marked in the valley of the Ilanka river (Ziemia Lubuska, western Poland) in the years 1999-2006. 54 nests built by 16 marked females were located in a relatively small area. The remains of 5 other nests, belonging to unknown females and damaged by predators were found in 3 localities in the vicinity of the main study area. 3 out of all marked females laid eggs once, the remaining 13 females 2-7 times. Cases when females laid eggs at least two times were taken into account i.e. 51 nests. Females laid eggs on steep, sunny mid-forest clearings with areas of 375 m^2-1170 m^2 and situated at a distance of 69-83 m (aver. 77 m) from water bodies. Apart from the nesting grounds studied, 5 disturbed nests mentioned above were located at a distance of 150-270 m from water bodies. The distance between nests was 0.75-53.9 m (aver. 8.8 m). Most females consistently, each year opted for the same nesting sites (nests) as previous years. Successional vegetation growth and overshadowing of the clearings led to the use of locations in nearby areas. Once overshadowing was eliminated, females returned to locations in which they had been observed previously.

Key words: Reptilia, Testudines, Emydidae, *Emys orbicularis*, nest-site fidelity, Lubuskie province, western Poland.

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I. INTRODUCTION

The European pond turtle *Emys orbicularis* is a rare and endangered species in western Poland and Europe. Although the species is known from several dozen sites, only a few of them have several individuals recorded (MACIANTOWICZ & NAJBAR 2004). The majority of the sites are in the process of loosing the species. There is a similar situation in regions located close to our research area i.e. Brandenburg (SCHNEEWEISS 1996, 1997, SCHNEEWEISS & FRITZ 2000) and Wielkopolska (RYBACKI et al. 2001).

Despite the fact that the geographical distribution of the European pond turtle is fairly broad in Eurasia, reaching as far as northern Africa, and although the species is subject to numerous research

studies (FRITZ 2003), there is little information available in the professional literature on the choice of locations for nests sites by females. Such knowledge is essential for the purpose of planning and implementing efficient protection of the species and long term research is particularly useful. The most exhaustive data on this issue relating to Poland comes from MITRUS (2006a, b) who carried out research on the turtle population from the Radom region.

The data presented here applies to the population of this turtle in Ziemia Lubuska, inhabiting the mouth of the Ilanka river. Although turtles had been observed in this area between the 1960s and 1980s, the first individuals were marked in 1998, and regular observations have been carried out since 1999 (NAJBAR & SZUSZKIEWICZ 2005).

The primary aim of the paper is to present the research on nest site fidelity which is a key issue in planning the protection of the species.

II. STUDY AREA

The study area covers several kilometers on the right-bank of the mouth of the Ilanka river – the tributary of the Odra. Here there are floodplains and channels which cross sandy areas and cut into them creating a valley, whose average width approximates 0.5 km and which in some places has steep banks. Locations of nesting sites of the European pond turtle include sandy and sunny slopes, overgrown with varied xerothermic flora mainly of the Spergulo-Corynephoretum canescentis (Tx. 1928) Libb 1933 and Sedo-Scleranthetea Br. -Bl. 1955 em Müller 1961 types (NAJBAR & SZUSZKIEWICZ 2005).

Mid-forest clearings (nesting sites), which were the main subject of our research, have a varied geomorphology and in general are surrounded by dense forest. Pine forest of the Leucobryo-Pinetum Mat. (1962) 1973 and Cladonio-Pinetum Juraszek 1927 type prevail in dry places located at higher altitudes. In these locations slopes are covered with varied floral complexes, mainly acacia forest, with among others Chelidonio-Robinietum Jurko 1969 characteristics. However, the wettest locations are covered by riparian forest of the Fraxino-Alnetum Mat. 1952 type, alder groves of Cardamino-Alnetum (Meijer Drees 1939) Pass. 1968 type and thick willow brushwood of the Salicetum albo-fragilis R. Tx. 1955 type (taxonomy based on MATUSZKIEWICZ 2001). The pine and acacia forests are subject to management run by the Forest Inspectorate in Rzepin, whereas most marshy areas remain unused (unpubl. data of the Forest Inspectorate in Rzepin).

The three nesting sites in this study are located close to one another and cover relatively small areas. In principle they could be treated as one nesting site, but because they are separated by forest, they were marked as L1, L2 and L3. L1 covers an area of approx. 1170 m^2 (45 x 26 m), L2 covered an area of 375 m^2 (25 x 15 m) in the years 1999-2003, and after trees had been cut there (2003/2004) it was enlarged to approx. 700 m^2 (35 x 20 m), and L3 covers an area of approx. 700 m^2 (35 x 20 m) (Fig. 2). The areas are square in shape, since this is how they are prepared by forest workers for the purpose of planned afforestation. The last time this was carried out was 1998.

Nesting sites face the south and south-west, and the inclination of the slopes varies from 5% to more that 40%. The sites are located in proximity to marshy areas and water bodies i.e. close to a branch of a channel that supplies the main stream of the Ilanka river, which is slow flowing and silty (Fig. 1). This is where most observations of turtles took place.

III. MATERIAL TIME AND METHODS

The research was carried out between May 1999 and June 2006. All females were marked at first capture by notching the marginal scutes. At the end of May and at the beginning of June each year, i.e. during the period of egg laying, the nesting sites described above were observed. Immediately after egg laying females were identified and the nest location was permanently marked and meas-

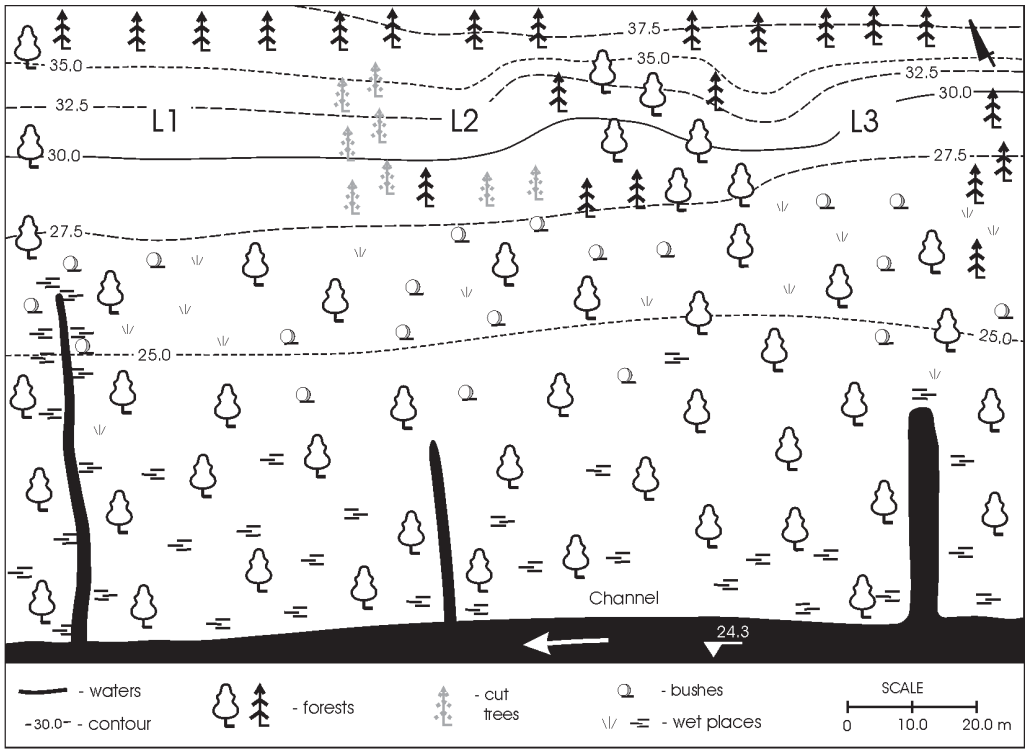

Fig. 1. Location and landforms of L1-L3 nesting sites.

ured in relation to other nests. Measurements were made to an accuracy of approx. 0.15 m. The distance between nests and water bodies was measured to an accuracy of up to 1 m with the use of a topographic map (P.P.G.K. 1985) and CAD system (Auto CAD LT 2000). Landform features of the area were drawn on the map.

This paper describes data relating to cases when particular females laid eggs at least twice.

IV. RESULTS

During the 8 year period 29 adult females of the turtle *Emys orbicularis*, were marked. Of those 16 (55.2%) laid eggs at the L1-L3 nesting sites, while 13 (44.8%) of them laid eggs 2-7 times (Fig. 2; Table I). On the whole, 54 nests were recorded, of which 51 were analysed (nests used once were omitted). Five other disturbed nests of unknown females, found in three different places outside the above mentioned nesting sites, were also omitted from the analysis. 21 nests were built in the areas L1 and L3 (2 x 41.2% i.e. 82.4%), the remaining 9 (17.6%) were built in area L2 (Fig. 2). The distances between the nests varied and with particular females ranged in different years from 0.75 to 53.9 m. The average distance between nests was small and amounted to 8.8 m (Table I).

Females laid eggs at small distances from water bodies. Disregarding a narrow channel near L3 and L2, and small water courses having their source in the nearby banks in L1 and L2, the nests were located at a distance of 69-83 m (aver. 77 m) (Table I) from the main river channel.

A significant majority of observed females entered the nesting sites from the south or south west i.e. from the side of the water bodies they used to approach the nest sites. Once nesting sites had been reached, females did not start digging nests immediately, but would wander around, crossing their route several times and sporadically migrating to neighbouring nesting sites.

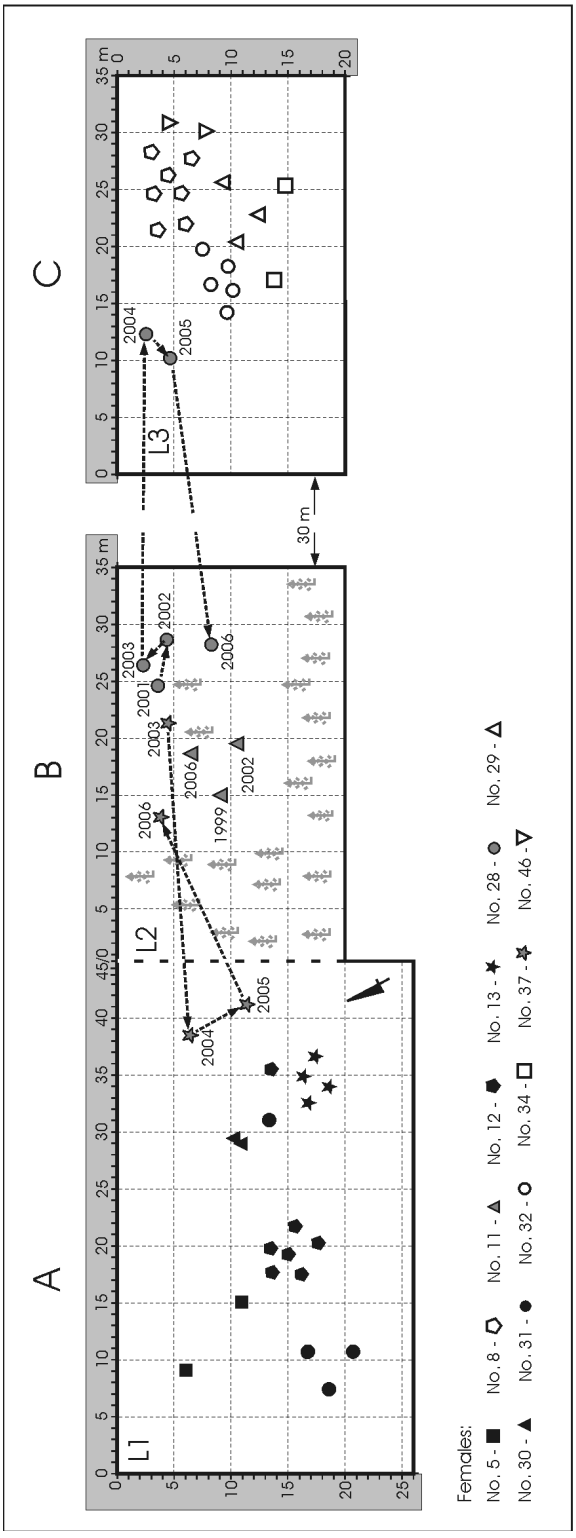

Fig. 2. A-C – dimensions of L1-L3 nesting sites and locations of 51 nests of the European pond turtle recorded in the years 1999-2006; L2 – area after cutting trees. Arrows indicate subsequent locations of nests of females Nos 28 and 37 (description in text).

Table I

Number of nests, their location and the distances between them relative to the number of females of the European pond turtle

No.	No. of the female (location where eggs were laid)	No. of nests	Distance between nests min./max. (aver.) [m]	Distance between nests and water min./max. (aver.) [m]
1.	8 (L3)	7	1.9/7.1 (4.0)	79/83 (81)
2.	12 (L1)	7	1.8/17.9 (6.8)	71/76 (73)
3.	28 (L2/L3/L2)	6	2.4/53.9 (28.7)	77/83 (81)
4.	32 (L3)	5	2.1/5.9 (3.2)	77/79 (78)
5.	13 (L1)	4	1.6/4.0 (2.6)	69/72 (71)
6.	31 (L1)	4	3.7/24.1 (13.0)	69/75 (72)
7.	37 (L2/L1/L2)	4	5.6/27.8 (17.7)	76/82 (80)
8.	11 (L2)	3	4.1/4.7 (4.4)	75/79 (77)
9.	29 (L3)	3	3.2/5.3 (4.2)	74/77 (76)
10.	5 (L1)	2	7.6	78/83 (81)
11.	30 (L1)	2	0.75	78/79 (79)
12.	34 (L3)	2	8.5	71/73 (72)
13.	46 (L3)	2	3.2	78/81 (80)
Total		51	0.75/53.9 (8.8)	69/83 (77)

V. DISCUSSION

The European pond turtle is a long-lived species and some researchers believe that females can be sexually active for several dozen years (e.g. JABŁOŃSKI 1998, JABŁOŃSKI & JABŁOŃSKA 1998, 1999). Yet, no more detailed data is available on this issue.

In most of the area of occurrence of the turtle, particularly in its northern part, females lay eggs once a year (e.g. JABŁOŃSKI & JABŁOŃSKA 1998, MEESKE 1998, SCHNEEWEISS et al. 1998, MITRUS & ZEMANEK 2000, NAJBAR & SZUSZKIEWICZ 2005), whereas in its southern part this is twice a year (e.g. TETRYSZNIKOW & GOROWAJA 1984, FRITZ et al. 1995) or even three times in one season (BANNIKOW 1951, KELLER 1999).

During the egg-laying period females undertake journeys in order to find suitable locations for their nests. Information on this issue obtained in central Europe indicates that they migrate both in water and overland covering various distances often reaching several hundred metres, and even a few kilometres (e.g. ZEMANEK 1988, JABŁOŃSKI 1998, JABŁOŃSKI & JABŁOŃSKA 1998, PAUL & ANDREAS 1998, SCHNEEWEISS & STEINHAUER 1998). The issue is subject to thorough research in the present study area. So far the longest observed journey of a female (No. 5) covered, in a straight line, is approx. 1.7 km, out of which majority – up to 1.5 km – took place in water.

Leaving the water, egg laying and returning to water usually takes females several hours, yet as ZEMANEK (1988) and JABŁOŃSKI & JABŁOŃSKA (1998) have shown, in some cases these activities can take much longer. In our research we did not observe any long-term, overland journeys and cases when the search for a nesting site was abandoned (i.e. by hiding among plants until the follow-

ing day or returning to the water and subsequently digging a nest several days later) resulted from females being disturbed by people or animals (NAJBAR & SZUSZKIEWICZ 2005).

Some parts of the mouth of the Ilanka river, in the area where the presence of turtles was observed for the first time by Radkiewicz (1967), are surrounded by sandy banks whose height and inclination relative to the water surface of the mainstream of the river and its channels are varied. Unfortunately, most of the banks – once semi-open habitats – have been afforested over several dozen years, mainly with acacia (black locust) *Robinia pseudacacia* L. and scots pine *Pinus sylvestris* L. Only a small part of the banks, on which sun exposure prevented the growth of trees, have remained open. These tiny fragments, according to the current state of knowledge, are the most important breeding sites for turtles. However, they are greatly in danger of becoming overshadowed, which is particularly evident at their edges, since each year consistently higher trees cast shadows enabling the growth of self-seeders.

Within only a few years of research we have observed that in the case of the L2 nesting site visited by females between 1999-2003, rapid growth of pines (on the western and southern sides) overshadowing most of the open area led to complete abandonment of egg laying. In order to increase sun exposure, in the winter of 2003/2004 trees were cut in the area between L1 and L2 and below L2 (Fig. 2) with some branches left on the ground. In seasons 2004 and 2005 no females were observed there. In autumn 2005 the ground was cleared and in 2006 increased interest in the area was observed among females, and two of them (No. 28 /Fig. 2B, C/ and No. 37 /Fig. 2A, B/) which had laid eggs there several years before, did so again. Also, another female (No. 11), after several years of absence (no data on where she laid eggs in the years 2003-2005), laid her eggs in 2006 (Fig. 2B) in the area where previously she had located her nests in L2 (1999 and 2002).

It seems that conservation of the research area, and other potential nesting sites, focused on the prevention of vegetation overgrowth which is essential for the purpose of preserving the breeding potential of the local population. This is particularly important when a space is significantly limited in terms of area, is subject to succession of vegetation and degraded due to littering (NAJBAR 2005). This is even more important because females choose nesting sites in well known places. These can even include locations where they were born. Occasional observations carried out in the valley of the Ilanka river between 1960 and 1980s (NAJBAR unpubl. data, RADKIEWICZ personal comm.) indicate that already at that time the presence of adult migrating females was recorded at the end of May and beginning of June in the locations described above (probably the females were looking for appropriate nesting sites). The females look for nesting sites in strictly specified fragments of open areas which are appropriately exposed to the sun, which indicates strong nest-site fidelity of females. Although no exhaustive data applying to 29 marked females is available, in the case of 11 (84.6%) out of 13 individuals no change of their nesting site was observed over the period of 8 years.

The tendency among females to return to the same or nearby nesting sites over the period of several to several dozen years is confirmed by observations of e.g. JABŁOŃSKI & JABŁOŃSKA (1998) carried out in the Łęczyńsko-Włodawskie Lake District (eastern Poland), SCHNEEWEISS & STEINHAUER (1998) in Brandendburg (eastern Germany) and MITRUS (2006a, b) in the Borowiec Nature Reserve (central Poland). The last of these authors reports, on the basis of 16 years of observation, that some females nested in the same locations for more than 10 years, while others changed their nesting sites.

The distances between the nests of individual females were small. In the years 1999-2003 data related to 19 nests indicated distances of 0.75-8.5 m (aver. 2.0-4.5 m) (NAJBAR & SZUSZKIEWICZ 2005). However, intensive overshadowing of L2 led to migration of the above females: No. 28 from L2 to neighbouring L3 i.e. by more than 50 m (Fig. 2B, C), and No. 37 from L2 to L1 i.e. by almost 30 m (Fig. 2A, B). Observations indicate that covering distances of 30-50 m does not constitute a barrier for female turtles, and their migrations suggests that they actively look for the most appropriate places for laying eggs. If no such locations are available, e.g. as a result of area degradation, females look for new sites on field roads, in gravel pits etc. Five such cases were recorded after

finding remains of nests of unknown females located outside the nesting sites described above (L1-L3) at a distance of 150-270 m from water bodies.

The distances between nests recorded by us are smaller compared with the distances observed in central Poland (MITRUS 2006a, b), which probably results from the fact that in the present study area, there are no sufficiently large areas which could be used by female turtles as nesting sites. It is worth mentioning, that on the other side of the Ilanka valley (150-300 m) there are vast grass areas which could serve as nesting sites, yet apart from one recorded case (remains of turtle eggs in 1999), no females were observed. JABŁOŃSKI & JABŁOŃSKA (1998), RÓŻYCKI (personal comm.) researching one of the largest populations of the turtle in central Europe report the fact that particular females nest in the same locations for several years and frequently build their nests close to one another. This also happens in relatively large nesting areas.

The research carried out in the valley of the Ilanka river on the choice of nesting sites by female turtles should be continued in view of the following facts:

– we are probably dealing with one of the last significantly numerous populations of the species in western Poland;

– preferred natural breeding areas have a tendency to shrink;

– so far, nesting sites of more than a dozen marked females have not been identified.

VI. CONCLUSIONS

1. Females of the European pond turtle inhabiting the mouth of the Ilanka river lay eggs at a distance of 69-270 m from water bodies, in open areas covered with xerothermic flora.

2. The results of 8 years of research indicate that most females lay eggs in the same places in each subsequent year, yet changes in the lighting conditions of a nesting site may make females look for more appropriate sites in the vicinity.

3. The monitoring of nesting ecology as well as appropriate protection and conservation of nesting sites of *Emys obicularis* in western Poland, which are relatively limited in their area and exploited economically, are the primary actions required for the efficient conservation of these local populations.

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